CLAIMS

What is claimed is:

1. In a cardiac stimulation device, a method of monitoring myocardial ischemia comprising:

determining a sensor indicated heart rate;

pacing at the sensor indicated heart rate;

sensing an intracardiac electrogram signal;

detecting myocardial ischemia based on a change in the electrogram signal; and

in response to detecting myocardial ischemia, ignoring the sensor indicated rate and selectively adjusting one or more pacing parameters.

2. The method according to claim 1, wherein selectively adjusting one or more pacing parameters comprises varying a pacing rate.

3. The method according to claim 1, wherein selectively adjusting one or more pacing parameters comprises varying an inter-ventricular timing interval.

4. The method according to claim 1, wherein selectively adjusting one or more pacing parameters comprises varying an inter-atrial timing interval.

5. The method according to claim 1, wherein sensing the intracardiac electrogram signal comprises sensing a differential signal between a coronary sinus lead electrode and a right ventricular lead electrode.

6. The method according to claim 1, wherein sensing the intracardiac electrogram signal comprises sensing a differential signal between an active electrode and a case electrode.

7. The method according to claim 1, wherein detecting myocardial ischemia comprises detecting a deviation of an ST-segment of the cardiac electrogram signal.

8. The method according to claim 7, wherein detecting the deviation of the ST-segment comprises detecting any of:

an elevation of the ST-segment relative to a PQ-segment;

an elevation of the ST-segment relative to a TP-segment;

a depression of the ST-segment relative to a PQ-segment;

a depression of the ST-segment relative to a TP-segment;

and

an inversion of a T-wave.

9. The method according to claim 8, further comprising switching from a single-chamber ventricular stimulation mode to a biventricular stimulation mode.

10. The method according to claim 1, further comprising waiting for a predetermined time delay before responding to the detection of myocardial ischemia.

11. The method according to claim 1, further comprising monitoring for myocardial ischemia when the pacing parameters are automatically adjusted, in response to a physiologic signal.

12. The method according to claim 1, further comprising monitoring for myocardial ischemia on a continuous basis.

13. The method according to claim 1, further comprising monitoring for myocardial ischemia on a periodic basis in a patient known to be susceptible to myocardial ischemia.

14. The method according to claim 1, further comprising monitoring for myocardial ischemia following a user-programmed change in stimulation parameters.

15. The method according to claim 1, wherein sensing the cardiac electrogram signal comprises electrically coupling at least two sensing electrodes to form a single sensing electrode with an expanded surface.

16. The method of claim 15, wherein electrically coupling at least two sensing electrodes comprises temporarily shorting at least two sensing electrodes during a sensing window, within a ST segment.

17. The method of claim 16, wherein coupling at least two sensing electrodes comprises extending the ST segment for the full length of the ST segment.

18. The method according to claim 16, wherein electrically coupling at least two sensing electrodes comprises temporarily coupling at least two sensing electrodes by means of a switch.

19. The method according to claim 15, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a coronary sinus lead.

20. The method according to claim 15, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a right ventricular lead.

21. In a cardiac stimulation device, a method of monitoring myocardial ischemia comprising:

electrically coupling at least two sensing electrodes to form a single sensing electrode with an expanded surface;

sensing an intracardiac electrogram signal using the single sensing electrode; and

detecting myocardial ischemia based on a change in the electrogram signal.

22. The method according to claim 21, wherein electrically coupling at least two sensing electrodes comprises temporarily shorting at least two sensing electrodes during a sensing window, within a ST segment.

23. The method of claim 22, wherein coupling at least two sensing electrodes comprises extending the ST segment for the full length of the ST segment.

24. The method according to claim 21, wherein electrically coupling at least two sensing electrodes comprises temporarily coupling at least two sensing electrodes by means of a switch.

25. The method according to claim 22, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a coronary sinus lead.

26. The method according to claim 22, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a right ventricular lead.

27. A cardiac stimulation device that monitors myocardial ischemia, comprising:

a sensing circuit that senses an intracardiac electrogram signal;

a control circuit that determines a sensor indicated heart rate;

a pulse generator that generates stimulation pulses at the sensor indicated heart rate;

an ischemia detector, connected to the ischemia sensing circuit, that detects myocardial ischemia based on a change in the electrogram signal; and

wherein the control circuit is responsive to detection of myocardial ischemia to ignore the sensor indicated rate and to selectively adjust one or more pacing parameters.

28. The device according to claim 27, wherein the pacing parameters comprise a pacing rate.

29. The device according to claim 27, wherein the pacing parameters comprise an inter-ventricular timing interval.

30. The device according to claim 27, wherein the pacing parameters comprise an inter-atrial timing interval.

31. The device according to claim 27, wherein the change in the cardiac electrogram signal comprises a differential signal between a coronary sinus lead electrode and a right ventricular lead electrode.

32. The device according to claim 27, wherein the change in the cardiac electrogram signal comprises a differential signal between an active electrode and a case electrode.

33. The device according to claim 27, wherein the myocardial ischemia is confirmed when a deviation of an ST-segment of the cardiac electrogram signal is detected.

34. The device according to claim 33, wherein the deviation of the ST-segment comprises any of:

an elevation of the ST-segment relative to a PQ-segment;

an elevation of the ST-segment relative to a TP-segment;

a depression of the ST-segment relative to a PQ-segment;

a depression of the ST-segment relative to a TP-segment;

and

an inversion of a T-wave.

35. The device according to claim 27, further comprising a switch that electrically coupling at least two sensing electrodes to form a single sensing electrode with an expanded surface.

36. The device of claim 35, wherein the switch temporarily shorts at least two sensing electrodes during a sensing window, within a ST segment.

37. The device of claim 36, wherein the ST segment extends for substantially the length of the ST segment.

38. The device according to claim 35, wherein at least two sensing electrodes are located on a coronary sinus lead.

39. The device according to claim 35, wherein at least two sensing electrodes are located on a right ventricular lead.

40. A cardiac stimulation device that monitors myocardial ischemia, comprising:

circuitry that is operative to electrically couple at least two sensing electrodes;

an ischemia sensing circuit that senses a cardiac electrogram signal, using the coupled electrodes; and

an ischemia detector, connected to the ischemia sensing circuit, that detects myocardial ischemia based on a change in the electrogram signal.

41. The device according to claim 40, wherein the switch shorts at least two sensing electrodes during a sensing window, within a ST segment.

42. The device of claim 41, wherein the ST segment extends for substantially the length of the ST segment.

43. The device according to claim 40, wherein at least two sensing electrodes are located on any one or more of a coronary sinus lead and a right ventricular lead.

44. A cardiac stimulation device that monitors myocardial ischemia, comprising:

means for determining a sensor indicated heart rate;

means for pacing at the sensor indicated heart rate;

means for sensing an intracardiac electrogram signal;

means for detecting myocardial ischemia based on a change in the electrogram signal; and

wherein in response to detected myocardial ischemia the pacing means comprises means for ignoring the sensor indicated rate and for adjusting one or more pacing parameters.

45. The device according to claim 44, wherein the pacing parameters comprise any one or more of:

a pacing rate;

an inter-ventricular timing interval; and

an inter-atrial timing interval.

46. The device according to claim 44, wherein the change in the cardiac electrogram signal comprises a differential signal between a coronary sinus lead electrode and a right ventricular lead electrode.

47. The device according to claim 44, wherein the change in the cardiac electrogram signal comprises a differential signal between an active electrode and a case electrode.

48. The device according to claim 44, wherein the myocardial ischemia is confirmed when a deviation of an ST-segment of the cardiac electrogram signal is detected.

49. The device according to claim 48, wherein the deviation of the ST-segment comprises any of:

an elevation of the ST-segment relative to a PQ-segment;

an elevation of the ST-segment relative to a TP-segment;

a depression of the ST-segment relative to a PQ-segment;

a depression of the ST-segment relative to a TP-segment; and

an inversion of a T-wave.

50. The device according to claim 44, further comprising a switch that electrically coupling at least two sensing electrodes to form a single sensing electrode with an expanded surface.

51. The device of claim 50, wherein the switch temporarily shorts at least two sensing electrodes during a sensing window, within a ST segment.

52. The device of claim 51, wherein the ST segment extends for substantially the length of the ST segment.

53. The device according to claim 50, wherein at least two sensing electrodes are located on any one or more of: a coronary sinus lead and a right ventricular lead.

54. A cardiac stimulation device that monitors myocardial ischemia, comprising:

means for electrically coupling at least two sensing electrodes;

means for sensing a cardiac electrogram signal, using the coupled electrodes; and

means for detecting myocardial ischemia based on a change in the electrogram signal.

55. The device according to claim 54, wherein the switch means shorts at least two sensing electrodes during a sensing window, within a ST segment.

56. The device of claim 55, wherein the ST segment extends for substantially the length of the ST segment.

57. The device according to claim 56, wherein at least two sensing electrodes are located on any one or more of a coronary sinus lead and a right ventricular lead.

58. In a cardiac stimulation device, a method of monitoring myocardial ischemia comprising:

implementing a pacing scheme;

sensing an intracardiac electrogram signal;

detecting myocardial ischemia based on a change in the electrogram signal; and

in response to detecting myocardial ischemia, varying an inter-chamber timing interval in the pacing scheme.

59. The method according to claim 58, wherein varying the inter-chamber timing interval comprises varying an inter-ventricular timing interval.

60. The method according to claim 58, wherein varying the inter-chamber timing interval comprises varying an inter-atrial timing interval.

61. The method according to claim 58, wherein sensing the intracardiac electrogram signal comprises sensing a differential signal between a coronary sinus lead electrode and a right ventricular lead electrode.

62. The method according to claim 58, wherein sensing the intracardiac electrogram signal comprises sensing a differential signal between an active electrode and a case electrode.

63. The method according to claim 58, wherein detecting myocardial ischemia comprises detecting a deviation of an ST-segment of the cardiac electrogram signal by detecting any of:

an elevation of the ST-segment relative to a PQ-segment;
an elevation of the ST-segment relative to a TP-segment;
a depression of the ST-segment relative to a PQ-segment;
a depression of the ST-segment relative to a TP-segment; and
an inversion of a T-wave.

64. The method according to claim 63, further comprising switching from a single-chamber ventricular stimulation to biventricular stimulation.

65. The method according to claim 58, further comprising waiting for a predetermined time delay before responding to the detection of myocardial ischemia.

66. The method according to claim 58, further comprising monitoring for myocardial ischemia on a continuous basis.

67. The method according to claim 58, further comprising monitoring for myocardial ischemia on a periodic basis.

68. The method according to claim 58, further comprising monitoring for myocardial ischemia following a user-programmed change in stimulation parameters.

69. The method according to claim 58, wherein sensing the intracardiac electrogram signal comprises electrically coupling at least two sensing electrodes to form a single sensing electrode.

70. The method of claim 69, wherein electrically coupling at least two sensing electrodes comprises temporarily shorting at least two sensing electrodes.

71. The method according to claim 70, wherein electrically coupling at least two sensing electrodes comprises temporarily coupling at least two sensing electrodes by means of a switch.

72. The method according to claim 69, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a coronary sinus lead.

73. The method according to claim 69, wherein electrically coupling at least two sensing electrodes comprises coupling at least two sensing electrodes on a right ventricular lead.